Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

bugs. It is credible, moreover, that when larger amounts of the bugs are thrown into a fire to destroy them, even when not containing any arsenic, an incomplete combustion might take place, in which case carbonous oxide (CO) would be produced, which would certainly bring about the evil effects complained of. It may also be remarked that previous to the advent of the potato bug the potato plant itself had not been so freely handled as lately ; an inquiry as to the effects of the entrance of the minute hairs from the leaf into the skin, and also into the properties of the juice of the plant, might show cause for some symptoms complained of.

At this time, when the use of arsenious acid is forbidden in Germany in the manufacture of aniline colors, on account of its evil effects on animal organisms, it may not be thought improper to call the attention of the people of our country to the present use of arsenic in the culture of so universal a food plant as the potato.

◆

THE LITTLE MISSOURI "BAD LANDS."

BY J. A. ALLEN.

IN Western Dakota are what are termed the Little Missouri "Bad Lands," a region as picturesque and strange as the imagination can well conceive. As we leave the Missouri River at Fort Abraham Lincoln, the present western terminus of the Northern Pacific Railroad, the journey to these "Bad Lands" is mainly by the so-called Sully's Trail, which runs nearly due westward between the 46th and 47th parallels. The three hundred miles of treeless prairies that lie between the Missouri and Little Missouri rivers present us with nothing of remarkable interest. Gradually, as we advance westward, the grass becomes scantier and the cacti and sage bushes more abundant, evincing the increasing aridity of the climate. Isolated, conical mounds or "buttes," occasionally of considerable height, are seen at long intervals, and serve as important landmarks. The streams are few and small, the most of them dwindling towards the end of summer to a series of detached, brackish pools. Along the larger of them we meet here and there with little clumps of trees, or, more rarely, with continuous narrow belts of timber, consisting mainly of box-elder and cotton-wood, with a sprinkling of elm ; or occasionally they are made up almost entirely of oak. These ittle groves, sometimes a day's journey apart, constitute the only trees met with, — little wooded oases in a vast expanse of rolling, grassy prairie. In crossing these prairies we miss, even in June, when the vegetation is in its greatest freshness, the variety and profusion of flowers that give to the more southern prairies the aspect of a vast flower-garden, — the patches of pink, orange, yellow, and other bright tints produced by the social grouping of the prevailing species, which impart their own hues to broad areas of the landscape, as do often the buttercups and daisies to New England hill-sides. Most conspicuous on the Dakota prairies, west of the Missouri, are the little prairie roses (*Rosa blanda* Ait.), which fill the air with their delicate perfume, and seem often to almost cover the ground in their abundance. These gems of the prairie in a measure atone for the absence of a greater variety of showy flowering plants.

Bird life is abundant over these prairies, they being everywhere enlivened by the few peculiar kinds, such as larks, buntings, and sparrows, that so eminently characterize the Plains. Among them, however, the ornithologist detects with delight both the Missouri skylark (*Neocorys Spraguei* Scl.) and Baird's bunting (*Centronyx Bairdii* Bd.), species which until a few years since were among the least known of the birds of the continent. Few mammals attract our attention, the prong horn, or so-called "antelope" (*Antilocapra Americana* Ord), being the chief, which, while notable for its grace and beauty, is also the principal game animal of this portion of the Plains; the American bison, or "buffalo," which existed here but a few years since, and whose trails still remain, having now wholly disappeared from the region east of the Yellowstone. The "prairie-dog towns" are somewhat frequent, their little occupants being ever objects of interest; occasionally the prairie hare (*Lepus campestris* Bach.), or jackass rabbit, as more commonly called, surprised by our approach, scampers away in all possible haste, his immense ears and very long legs giving him the appearance of being much larger than he really is.

After days of pleasant journeying amid such scenes as these, we find ourselves upon the border of the "Bad Lands," to the exploration of which we have long looked forward with so much interest. Though they are but a few miles distant, there is nothing as yet to indicate their proximity; we see before us only the same low ridge that in prairie landscapes seems ever to bound the horizon. Reaching the crest of this low ridge, however, we have before us, instead of another similar swell, one of the strangest vistas the continent affords. We look down upon a broad valley studded with detached, nearly bare, conical, pyramidal, and rectangular mounds, one hundred to several hundred feet in height, and a few yards to many hundred yards in length. All are similarly capped with a stratum of bright red, indurated clay, which on closer examination proves to have been metamorphosed by heat, and to be mixed with cinders and other mineral substances that seem to have had a volcanic origin. The mounds themselves are made up of variegated shales, horizontally disposed, which, seen in section in the nearly vertical sides of the mounds, appear as parallel bands of yellow, brown, green, gray, black, and other tints, surmounted with red. This strange panorama extends for many miles, and as we gaze upon it for the first time we soon cease to wonder that General Sully, in his march through this region in 1864, should have likened it to "*hell with the fires out*," as he is currently reported to have done.

The trail we have chosen fortunately leads us through the very heart of this interesting country, so that the experiences of a single day even would be sufficient to give us considerable familiarity with the varied phenomena of a locality that may be taken as a fair illustration of the remarkable topography of an extensive region. By a difficult and winding descent we reach the valley of Davis Creek, through which we are to find our way to the Little Missouri. Our interest in our surroundings constantly increases, as at every step some new feature, noticeable for its picturesque effect or as illustrative of some geological force, attracts our attention. The mounds and ridges increase in height, their rounded summits still capped with bright pink shale, and almost verdureless. Red bands are also seen at intervals in the sides of these mounds, these bands being composed of the same baked, reddened clay as that covering the summits, with generally a thin layer of scoriaceous material at the bottom of each red band. Although traces of fire are so evident, the force that has given the country its present broken character has been the gentle action of water. The strata everywhere preserve their almost perfectly horizontal position, these buttes and sharp, narrow ridges being but the remains of strata that once filled the country to a higher level than even the tops of the highest buttes now standing. By the slow process of aqueous erosion have the soft strata of sands and clays been removed, and the country scored to the depth of hundreds of feet.

But other forces have been at work. Heat of great intensity, and from an unusual source, has also acted here on a grand scale, but as a preserving rather than as a destroying agent. Beds of lignite, a few inches to several feet in thickness, occur interstratified with the deposits of sand and clay. The deep, sharp gullies formed by the action of water have exposed these beds of lignite for long distances. This exposure to atmospheric influences seems to have in some way produced spontaneous combustion of the lignite, for there is abundant evidence that some of the igneous action about to be described occurred before the close of the terrace epoch. Whatever may have caused the coal beds to take fire, the fact remains that for long ages their destruction has been going on, and even still continues, producing geological results of a most interesting and important character. When once well ignited they seem to burn for long periods, the fires penetrating far into the interior of the hills, extending at times till all the coal seams over very large areas are consumed. At the present time these fires are known to sometimes originate from the prairie fires, which occasionally sweep over these lignite exposures and ignite the coal. But a large proportion of the beds that have been destroyed appear to have been so situated that prairie fires could not have reached them, the exposures being about midway up the bare, nearly vertical faces of very high bluffs. Wherever the lignite beds have been burned, their former position can be easily detected by the bright red bands of the hardened overlying clays and sands which have been metamorphosed by their combustion, these red bands being often traceable by their color for long distances, occurring at the same level in butte after butte.

The burning of such large masses of lignite must of course, especially when the beds have considerable thickness, produce an intense heat; yet the metamorphism here seen seems sometimes to be on too grand a scale to be the result of so limited a cause. The thickness of the strata more or less changed in texture and color by the heat varies, of course, with the thickness of the seam of lignite the burning of which was the source of the metamorphic action, and hence ranges from a few feet to twenty or thirty, and occasionally to upwards of fifty! In many cases the heat was sufficient to partly or wholly fuse the shales immediately in contact with the burning lignite, giving them a semi-vitreous or porcelaneous texture. At the bottom of the series of metamorphosed beds we have usually a layer of cinders and clinkers, which occupies the position of the former lignite bed itself. This layer is generally of a whitish or grayish color, and is made up largely of hard, semi-vitreous, vesicular material, the larger interstices of which are filled with ashy or earthy matter, while occasionally portions are so soft as to be easily crumbled in the hand, or crushed under the foot. Indeed, it is not much unlike the residuum left in our grates from the burning of common coal.

The material next above this often shows signs of having been in a semi-molten or at least plastic condition, and generally presents a great variety of tints, as olive, drab, yellow, gray, white, brown of various shades, purple, and even black. The purple and olive tints are quite frequent; the other colors often occur in narrow zones or mere lines, producing a very beautiful effect. The texture varies from a dense, compact, jaspery character to that so porous and vesicular that the mass will float upon water, with every degree of porosity between these extremes. This variegated layer is usually but a few inches in thickness, and is of rather local occurrence, as is also the scoriaceous or vesicular matter, neither appearing except where the heat has been very intense. The scoriaceous material also varies greatly in color, being usually black, but sometimes grayish, while it also occurs of every shade of red, from dark reddish-brown to bright carmine. These materials always pass gradually into the overlying reddened, baked clays, which, as previously stated, may vary in thickness from a few feet to twenty or more, and which, from their great thickness, bright color, and wide distribution, form one of the characteristic features of the region we are considering. The color of these beds is that of bright red bricks, and where the material has been thinly scattered about by the gradual demolition of buttes once covered by it, as sometimes happens, the resemblance of the locality to an old, long-abandoned brickyard is very striking. These hardened clays still retain the abundant impressions of plant-remains, but they are generally too fragmentary to be of much value as specimens. A few quite well-preserved casts of the leaves of exogenous plants occur, but the vegetable relics consist mainly of the imprints of broad-leaved grasses and sedges, which seem to have in places nearly filled the clays. Heavy clay deposits almost always immediately overlie the beds of lignite, and when they are very heavy, or the seam of lignite is very thin, the metamorphism scarcely extends beyond the stratum of clay; usually, however, it affects the stratum of sand that rests upon the clay, sometimes converting it into a red, coarse-grained, rather soft sandstone, hand-specimens of which are scarcely, if at all, distinguishable from the red sandstone of the Connecticut Valley. The metamorphism gradually ceases in passing upward, as respects both color and hardness, till the influence of the heat wholly disappears. The color of these metamorphosed shales thus fades from intense red, or even black, through light brick-red to pale red and pale reddish-yellow; whilst the texture varies from crumbling scoria and slag, through rock of a trappean texture and conchoidal fracture, to finely fissured baked clay and sandstone, and finally to shales but slightly hardened and almost unchanged in color.

The beds thus altered often present interesting features of structure, the indurated clays being extremely fissile, breaking up into thin, small, irregularly shaped splinters and fragments, which possess a clear, metallic resonance; the sandstones occasionally present a prismatic structure, with the planes of cleavage oblique to those of stratification, the mass breaking into five or six sided prisms, half an inch to an inch or two in diameter, and one or two to even two and a half feet in length, almost slender enough and long enough for walking-sticks!

As already intimated, the beds of lignite vary greatly in thickness, from a few inches to five or six feet, and even more,[1] with corresponding variations in the amount of metamorphism produced by their combustion. In the burning of the heavier of these beds not only is an immense amount of heat generated, but vapors are formed which, in escaping, have also left their interesting records. These consist of jagged, chimney-like mounds of breccia that still crown many of the buttes and ridges, the softer materials that surrounded them having been worn away by denuding agencies, leaving them as striking and picturesque features of the landscape. These mounds have sometimes the form of short, thick columns, being circular, a foot or two in diameter and a few feet high; at other times they are ten or twelve feet in diameter and of about the same height, while they not unfrequently assume the form of low, narrow, ragged walls of highly altered rock, the material of all these erupted mounds presenting the features of a true volcanic breccia. The matter composing these chimneys was mostly forced up through small orifices or narrow fissures,

[1] Near the mouth of Powder River I met with two beds, one five and the other eight feet thick, separated by only about three feet of shale. On Custer's Creek I also met with a heavy bed, which varied in thickness at different exposures from six to ten feet. A considerable amount of metamorphic action may readily be conceived as resulting from the combustion of such large masses of lignite, some of which has nearly the heat-producing power of cannel coal.

while in a plastic or half-molten condition. At these points the heat was so great that the sands and clays through which the fissures extended became thoroughly melted, leaving the walls of these fissures with glazed surfaces, vitrifying them to depths varying from half an inch to several inches. In some instances the melted matter ran down while in a viscous state, solidifying in pendant, rounded masses; in other cases it was squeezed out through lateral cracks in the walls of the main fissures, congealing in similar botryoidal forms. Again, masses are seen in these chimney-like mounds that seem to have been twisted and folded when in a viscous state, the surface still retaining its waxy lustre.

In connection with the formation of these fissures and mounds there were slight disturbances of the adjoining strata, affecting sometimes an area of only a few feet in diameter, and rarely extending over many yards. Occasionally, however, the fissures extended for considerable distances, accompanied by the usual phenomena of intense igneous action already noticed, with a disturbance of the strata for several yards on either side of the fissure, where many feet in thickness were lifted and still remain highly inclined. We have here, in fact, a series of volcanic puffs, or *volcanoes in miniature*, having their seats of action in the burning coal-seam, ten, fifteen, or perhaps fifty feet below. Indeed, some of these disturbed areas present a very broken and volcanic aspect, and a geologist suddenly transported to one of these localities would feel at first that he must be in the midst of a truly volcanic district. He would find that from the tops of these apparently volcanic ridges blocks of scoriaceous material, differing in no respect from real volcanic products, have rolled down into the adjoining valleys, and lie scattered in masses varying from a foot in diameter to those of several tons' weight. The ragged masses of rock crowning the higher points of the ridges, like ruined battlements, with the adjoining chasm-like ravines, faced with highly metamorphosed rock, do combine, in fact, to present quite a disturbed and chaotic scene; yet a careful examination of even these localities shows that the strata are everywhere horizontal, save at such few limited areas as those already noticed. We find here, as usual, the horizontal beds of cinders underlying the metamorphosed strata, differing from those of other localities only in their greater thickness, and pointing out most conclusively the origin and cause of these local disruptions and former intense igneous action. That the burning of the lignite beds is really competent to produce all these effects we have the abundant stratigraphical proof afforded by this whole region, and the further testimony of trustworthy eye-witnesses, who have seen the beds of ligniteon fire with the same phenomena resulting as those above described.

The effect of this metamorphic action, when we consider its cause, upon the general topographical and geological features of the region under consideration, is wonderful almost beyond conception. Wherever the country is deeply scored by ravines usually several of these red bands of metamorphosed shales occur, separated by fifty to one hundred and fifty or more feet of unaltered clays and sands, and, running horizontally and parallel to each other, are seen for many miles, passing at the same elevation through butte after butte and ridge after ridge. The highest points are invariably capped with this hardened material, and hence all rise to about the same level over an area of many square miles. Generally there are several sets of these elevations, differing only in size and height, the hardened bands that cap the smaller and lower appearing at the same elevation in the sides of the larger and higher, which are capped with portions of higher beds that have nearly disappeared. The indurated beds thus in a great measure determine the height and form of these remnants of strata which once filled the valleys to a height considerably above the tops of the highest points now left, and serve as a great check upon the surprisingly rapid erosion now going on, and which is every year removing vast quantities of the easily yielding strata.

The extent of the influence of this igneous action upon the general aspect and character of the country is perhaps most impressively seen from elevations that overlook considerable areas of these strange "Bad Lands;" the scene of course varying greatly in its topographical details with every change in the position from which it is viewed. From a high point on the western bank of the Little Missouri, nearly opposite the mouth of Davis Creek, the view is that of a vast expanse of verdureless mounds and walls of naked rock, interspersed here and there with little grassy plateaux, and crossed by the green valley of Davis Creek, with its scanty fringe of low trees. Bright red is the prevailing color of the landscape, but in the nearer ridges the bands of yellowish-brown, dark-brown, and grayish shades are also distinguishable. The surface of the country is everywhere deeply scored, some of the higher points being two hundred and fifty to three hundred feet above the bed of the Little Missouri, and the eye catches little else than the bare, more or less metamorphosed shales. Each hardened band forming a considerable check to the eroding forces, the country presents a series of narrow terraces; these, being covered with a scanty growth of vegetation, form little plats and strips of green that pleasantly relieve the otherwise unbroken expanse of barrenness. Such a scene of wildness and desolation seems like a glimpse, as it were, of a half-formed world, unfit as yet for the habitation of man or for his uses.

A more extensive view of the Little Missouri "Bad Lands" is obtainable from the Sentinel Buttes, two high points situated on the western border of this remarkable region, and reaching an elevation of about six hundred feet above the Little Missouri. The horizontal position of the strata composing these elevations shows what a vast amount of material has been removed from the surrounding region by the slow action of denuding forces. The country presents, as we look eastward from these buttes, an almost continuous expanse of low, red-capped ridges and buttes, the prevailing red color being relieved only by bands of yellowish-brown and gray tints formed by the unaltered shales exposed in the deeply cut ravines. In this direction the view consists almost wholly of bad lands, — a vast stretch of undulating, verdureless red surface, extending as far as the eye can reach, only the naked crests of the distant, red-capped buttes and ridges being visible. It is a scene not easily forgotten, so utterly barren, and yet so wild and picturesque. Its desolateness is doubtless greatly heightened by the contrast of green, rolling prairie which meets the eye when turned in the opposite direction. In looking northward or southward we have on the one hand a beautiful prairie landscape, broken only here and there by a low, red-capped butte or sharp ridge, while on the other is a boundless expanse of naked red mounds and ridges, — billows, as it were, of a fiery sea, — the transition from the one to the other being abrupt and strongly marked.

We have here before us but a portion of one of the numerous belts of these peculiar bad lands that occupy vast areas of Eastern Dakota and Western Montana. The Little Missouri "Bad Lands," with a breadth varying from twenty to thirty miles, extend for hundreds of miles along the stream from which they derive their name. Other equally remarkable areas appear at intervals along the Missouri, from the vicinity of Fort Berthold nearly to the Judith River, or for a distance of fully five hundred miles. Another immense area occurs along the Yellowstone, extending from its mouth nearly up to the Big Horn River, or for several hundred miles, as well as for long distances up its lower tributaries. The valleys of the Rosebud, Tongue, and Powder rivers are, indeed, among the most noteworthy localities of these metamorphic phenomena, the hills being sometimes reddened as far as the eye can reach by the burning out of the lignite beds. This metamorphism is, in short, almost coextensive with the lignitic tertiary formation of the Upper Missouri, which occupies an area some five hundred miles in length by about three hundred and fifty in breadth, extending from near the 100th to about the 108th meridian, and from the vicinity of the 43d to far beyond the 49th parallel. Within this region, however, are occasional districts where this metamorphism occurs only in the higher, scattered buttes, the great areas of this disturbance and change being the borders of the principal water-courses, as the Missouri and its southern tributaries between the above-named points, including the Yellowstone and its eastern affluents.

JUMPING SEEDS AND GALLS.

AT a late meeting of the Academy of Sciences of St. Louis, Mr. C. V. Riley exhibited certain seeds which possessed a hidden power of jumping and moving about on the table. He stated that he had recently received them from Mr. G. W. Barnes, of San Diego, Cal., and that they were generally known by the name of "Mexican jumping seeds." They are probably derived from a tricoccous euphorbiaceous plant. Each of the seeds measures about one third of an inch in length, and has two flat sides, meeting at an obtuse angle, and a third broader, convex side, with a medial carina. If cut open, each is found to contain a single fat, whitish worm, which has eaten all the contents of the seed and lined the shell with a delicate carpet of silk. The worm very closely resembles the common apple worm (*Carpocapsa pomonella*), and indeed is very closely related, the insect being known to science as *Carpocapsa saltitans*. It was first recorded by Westwood in the Proceedings of the Ashmolean Society of Oxford, in 1857 (iii. 137, 138), and repeatedly referred to under the name of *Carpocapsa Dehaisiana* in the Annales of the French Entomological Society for 1859.

The egg of the moth is doubtless laid on the young pod, which contains the three angular seeds, and the worm gnaws into the suc-